Module Title: Module Title   © **UNIVERSITY OF LEEDS**

Mid-Term Paper

School of Physics and Astronomy   **Semester 1 2021/2022**

Calculator instructions:

- You are allowed to use a calculator or a computer calculator in this assessment.

Dictionary instructions:

- You are allowed to use your own dictionary in this assessment and/or the Spell Checker facility on your computer.

Assessment Information:

- There are 3 pages to this online assessment.

- You will have **1 hour and 30 minutes** to complete the assessment and upload your answers to Gradescope.

- You are recommended to take a **maximum of 1 hour** within the time available to answer the questions and the remaining 30 minutesto upload your answers.

- This assessment is worth 20% of the overall module mark

- Answer **all** of the questions in **all** of the sections of this paper.

- You must submit your answers via Minerva to Gradescope. You will find the link for uploading your work in the Assessment section of the module pages on Minerva in the same folder as you downloaded this paper from.

- Please include your Student Identification Number (SID) at the top of each page of your answers. You should **not** include your name.

- When submitting your work, you must identify which questions are answered on which uploaded pages. You must also check that you have uploaded all the work you wish to be marked as part of this assessment and that the answers uploaded are clearly legible. Failure to do so may result in your work not being marked.

- If there is anything that needs clarification about the questions in this paper, please contact the module leader by email and cc the Physics Exams team **physicsexams@leeds.ac.uk** and we will respond to you as quickly as possible within normal working hours UK time (9:00-17:00 hours, Monday-Friday).

- If you have any technical difficulties please contact the Physics Exams team at the address above **before the deadline for submission**.

- **This is a formal University assessment.** You must not share or discuss any aspect of this assessment, your answers or the module more generally with any-one whether a student or not during the period the assessment is open, with the exception of the module leader and Physics exams team.

Approximate values of some constants

Speed of light in a vacuum, c	$2.998 \times 10^8 \, \mathrm{m\,s^{-1}}$
Electron Charge, e	$1.602 \times 10^{-19} \, \mathrm{C}$
Electron rest mass, m_e	$9.11 \times 10^{-31} \, \mathrm{kg} = 0.511 \, \mathrm{MeV\,c^{-2}}$
Proton rest mass, m_p	$1.673 \times 10^{-27} \, \mathrm{kg} = 938.3 \, \mathrm{MeVc^{-2}}$
Unified atomic mass unit, u	$1.661 \times 10^{-27} \, \mathrm{kg} = 931.494 \, \mathrm{MeVc^{-2}}$
Fine structure constant, α	$1/137.036$
Planck constant, h	$6.626 \times 10^{-34} \, \mathrm{J\,s}$
Boltzmann constant, k_B	$1.381 \times 10^{-23} \, \mathrm{J\,K^{-1}} = 8.617 \times 10^{-5} \, \mathrm{eV\,K^{-1}}$
Coulomb constant, $\mathrm{k} = 1/4\pi\epsilon_0$	$8.987 \times 10^9 \, \mathrm{N\,m^2\,C^{-2}}$
Rydberg constant, R	$1.09373 \times 10^7 \, \mathrm{m^{-1}}$
Avogadro constant, N_A	$6.022 \times 10^{23} \, \mathrm{mol^{-1}}$
Gas constant, R	$8.314 \, \mathrm{J\,K^{-1}\,mol^{-1}}$
Stefan Boltzmann constant, σ	$5.670 \times 10^{-8} \, \mathrm{W\,m^{-2}\,K^{-4}}$
Bohr magneton, μ_B	$9.274 \times 10^{-24} \, \mathrm{J\,T^{-1}}$
Gravitational constant, G	$6.673 \times 10^{-11} \, \mathrm{m^3\,kg^{-1}\,s^{-2}}$
Acceleration due to gravity, g	$9.806 \, \mathrm{m\,s^{-2}}$
Permeability of free space, μ_0	$4\pi \times 10^{-7} \, \mathrm{H\,m^{-1}}$
Permittivity of free space, ϵ_0	$8.854 \times 10^{-12} \, \mathrm{F\,m^{-1}}$
1 Parsec, pc	$3.086 \times 10^{16} \, \mathrm{m}$
Solar mass, $M_\odot$	$1.99 \times 10^{30} \, \mathrm{kg}$
Magnetic flux quantum, Φ_0	$2.0679 \times 10^{-15} \, \mathrm{Wb}$

Some SI prefixes

Multiple	Prefix	Symbol	Multiple	Prefix	Symbol
10^{-18}	atto	a	10^{-9}	nano	n
10^{-15}	femto	f	10^9	giga	G
10^{-12}	pico	p	10^{12}	tera	T

- **This paper is worth 40 marks.**
- **You must answer all the questions.**
- **You are advised to spend 1 hour on this paper.**

1. 1. Mid-term papers only have "Section A" style questions which should test the breadth of the student's knowledge from weeks 1 to 5. Each question should be "standalone" in that they do not depend on a previous question in order for students to understand what they need to do. Questions should not include unseen problems [**2 Marks**]

2. Questions should be worth between 3 and 8 marks and not have multiple parts to them. Wherever possible ensure that students are required to provide eplanation or interpretation of their answer and/or produce some diagram as this makes it significantly easier to demonstrate collusion. [**5 Marks**]

3. Try to write the questions as simply as possible and avoid convoluted sentence structures. Avoid setting scenarios that include the student answering the problem – i.e. write "A person is in a balloon when. . . ." and not "You are in a balloon when... [**6 Marks**]

4. Only use **bold** for emphasis, do not use underline or *italics* or any other textual marks (including in rubric and instructions!) [**4 Marks**]

5. Text should all be Arial font, 12pt. Try to avoid the use of non-standard symbol fonts where possible as they can cause problems if they do not embed in the pdf correctly. Equations do not need to be sans-serif especially if it makes them less clear e.g. confusion between the digit 1 and the lower case letter l. [**7 Marks**]